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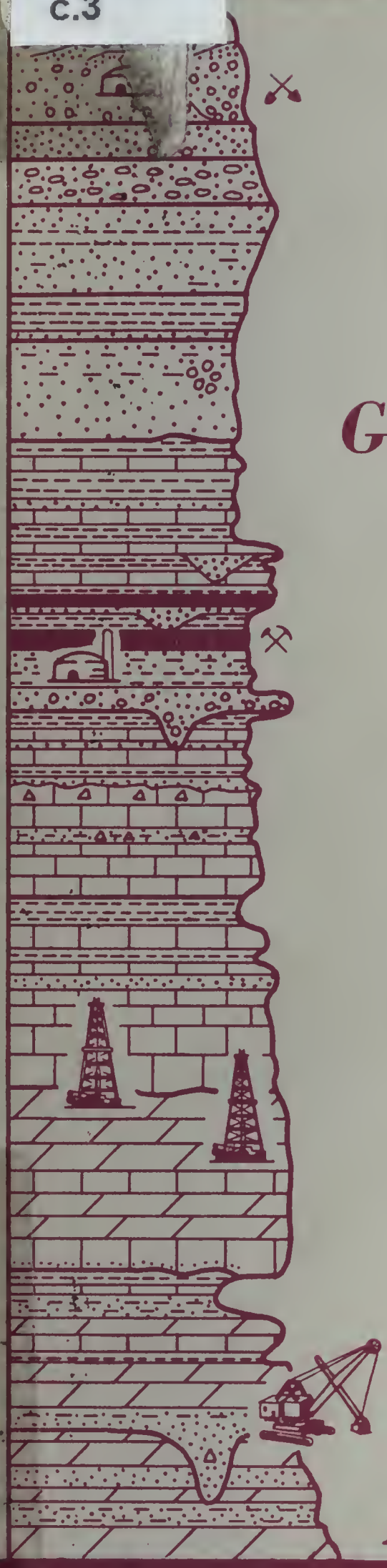

Guide to the

GEOLOGIC MAP OF ILLINOIS

Illinois State Geological Survey

TATE of ILLINOIS

Otto Kerner, Governor

DEPARTMENT of
REGISTRATION and EDUCATION

William Sylvester White, Director

1961

ILLINOIS STATE
GEOLOGICAL SURVEY
John C. Frye, Chief
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Guide to the
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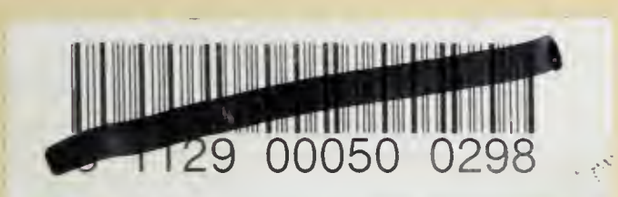


Guide to the GEOLOGIC MAP OF ILLINOIS

GLACIAL GEOLOGY

ALTHOUGH THE AGE OF THE EARTH is measured in billions of years, the face of Illinois is young - a mere 15,000 years old.

During the Ice Age, most of Illinois was repeatedly invaded by huge glaciers, sometimes towering a mile or more high, that carried embedded in them ground up rock materials they had gouged out of the bedrock to the north as they ponderously pushed south.

When the last of the glaciers melted from Illinois, about 15,000 years ago, the country that emerged looked far different from the preglacial land. Old hills and valleys had vanished, new ones had formed, and a mantle of unconsolidated rock material, the burden carried by the ice and dropped as the ice melted, lay over most of the region.

Most of this material, called glacial drift, was brought in by the ice during the last two of the four major periods of glaciation — the Illinoian period 100,000 to 150,000 years ago and the Wisconsinan 5,000 to 50,000 years ago. The older drift introduced during the Kansan and Nebraskan glacial periods is almost entirely buried beneath the later drifts.

The glaciers covered all of Illinois except the northwestern corner, the southwestern edge along the Mississippi River, and extreme southern Illinois, as shown in figure 1. In those areas the land is much as it was before the glaciers came. In the glaciated portion of the state, however, the bedrock generally is covered by the rock debris the ice carried from as far away as Canada.

As the fringes of the ice melted, these loads of rock material were, in some places, dumped as ridges (moraines) which are the hills and mounds on the flat prairies of the present landscape. Such material also filled ancient river valleys, but new valleys were cut by torrents of water released by the melting ice.

The glacial drift belongs to the youngest (topmost layer) of the major divisions of our rocks, which geologists have named the Pleistocene (scientific name for Ice Age deposits).

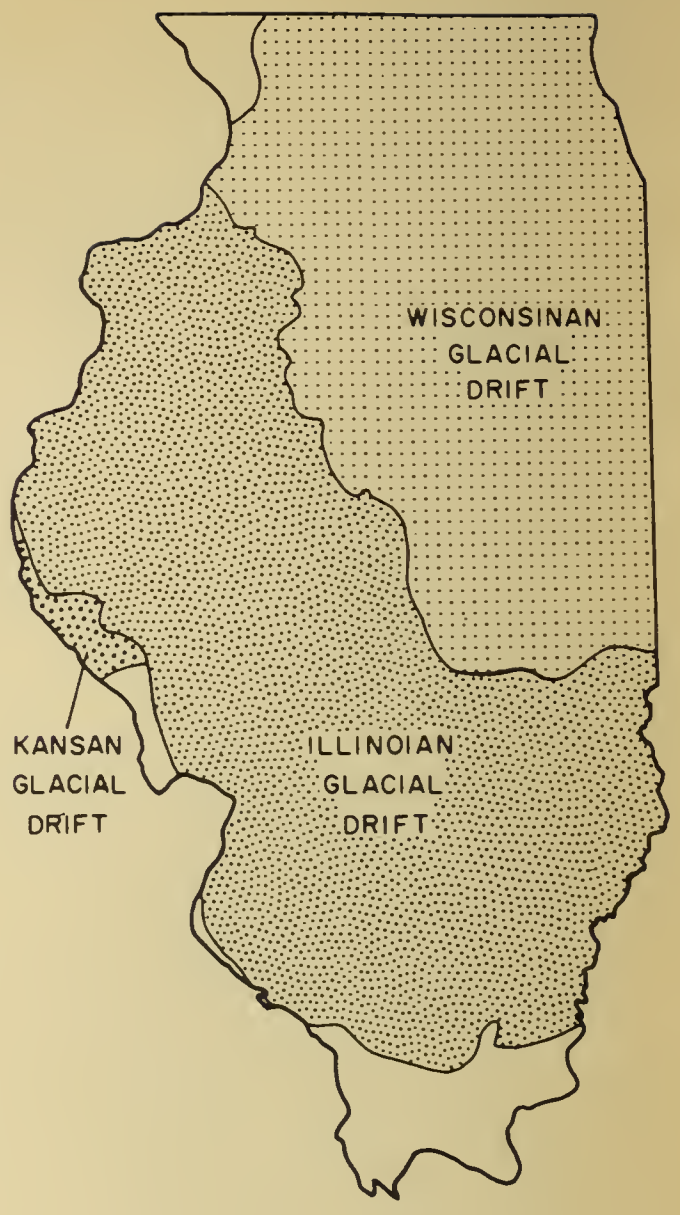


Figure 1 - A mantle of glacial drift covers the bedrock in much of Illinois.

Most of the drift is an unsorted mixture of clay, pebbles, and boulders called "till," but some glacial deposits consist of water-sorted sand and gravel carried and deposited by meltwater from the glaciers. Other materials were deposited by the wind — sand was piled into shifting dunes and fine silts were spread like a blanket over the land. This mantle of silt is called loess.

The glacial deposits contain a wide variety of rocks, some brought from regions to the north, others scoured from the layers of native rock in Illinois.

The limits of the Illinoian, the Wisconsinan, and the Kansan glaciations are shown in figure 1. Some of the more prominent moraines are sketched with dark gray

lines on plate 1. Within this area, glacial drift covers the bedrock except along valleys where streams have cut through and removed it.

BEDROCK GEOLOGY

Beneath the glacial drift of Illinois many layers of rocks overlie a base of ancient crystalline rocks that in Illinois occur at depths of 2,000 to as much as 15,000 feet. The geologic map (plate 1, in pocket) is drawn as if the mantle of glacial drift had been removed to expose the layers of bedrock, which are largely limestone, shale, and sandstone.

The key on the map shows the age sequence of the rocks, arranged with the youngest at the top, and gives the names that geologists have assigned to the various systems of rocks. Each system consists of rocks that were deposited during a long period of time. The complete sequence of rocks might be likened to a book of earth history, and each system likened to a chapter. Systems are divided into formations, which might be regarded as pages in the book.

As shown on the generalized rock column in figure 2, the rocks next older than the glacial drift (Pleistocene) are the Tertiary and Cretaceous sands, gravels, and clays, mostly unconsolidated. They occur only at the extreme southern tip of Illinois and were deposited when that area was covered by a northward extension of the Gulf of Mexico. The Tertiary rocks are shown on the map in grayed pink (T) and the Cretaceous in red-violet (K).

Next older than the Cretaceous are the Pennsylvanian rocks, named for the state of Pennsylvania where they are well exposed and were first studied.

The Pennsylvanian System is divided into two areas on the map (P^1 and P^2). The rocks shown in lightest gray (P^2) lie above the No. 6 Coal in the sequence and those in medium gray (P^1) lie below it. The No. 6 Coal is one

Era		Period or System and Thickness	Epoch	General Types of Rocks
CENOZOIC "Recent Life"	Age of Mammals	Quaternary 0-500'	Pleistocene or Glacial Age	Recent—olluvium in river volleys
				Glacial till, glociol outwash, grovel, sond, silt, lake deposits of cloy ond silt, loess ond sand dunes ; covers nearly oll of stote except northwest corner and southern tip
		Tertiary 0-500'	Pliocene	Chert gravel; present in northern, southern, and western Illinois
			Eocene	Mostly micoceous sond with some silt and clay; present only in southern Illinois
			Paleocene	Mostly cloy, little sond; present only in southern Illinois
MESOZOIC "Middle Life"	Age of Reptiles	Cretaceous 0-300'		Mostly sond, some thin beds of clay ond, locolly, gravel; present only in southern Illinois
PALEOZOIC "Ancient Life"	Age of Amphibians and Early Plants	Pennsylvanian 0-3,000' ("Coal Measures")		Lorgely shole ond sondstone with beds of cool, limestone, ond clay
		Mississippian 0-3,500'		Black and groy shale at bose; middle zone of thick limestone thot grodes to siltstone, chert, ond shole; upper zone of interbedded sondstone, shale, and limestone
	Age of Fishes	Devonian 0-1,500'		Thick limestone, minor sandstones and shales; lorgely chert ond cherty limestone in southern Illinois
	Age of Invertebrates	Silurian 0-1,000'		Principolly dolomite ond limestone
		Ordovician 500-2,000'		Lorgely dolomite ond limestone but contoins sondstone, shale, ond siltstone formotions
		Cambrian 1,500-3,000'		Chiefly sondstones with some dolomite ond shole; exposed only in small oreos in north-centrol Illinois
ARCHEOZOIC and PROTEROZOIC				Igneous ond metamorphic rocks; known in Illinois only from deep wells

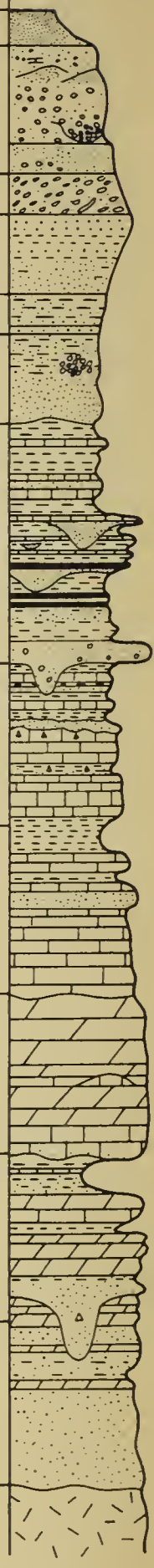


Figure 2 - Diagram of layers of rocks in Illinois. The oldest rocks are at the bottom, the youngest at the top. Names are the standard ones applied by geologists to the subdivisions of the geologic eras.

of the thickest, most valuable coals in the state. Pennsylvanian rocks occur under the glacial drift, and their thickness ranges from a few feet to as much as 3,000 feet.

The Pennsylvanian System contains many different kinds of rocks, including all of our minable coals. It also contains important deposits of limestone, shale, and clay, and at places oil and gas.

Next below the Pennsylvanian are the rocks of the Mississippian System, shown in blue on the map (M^1 and M^2). The lower and middle Mississippian rocks (M^1) are largely limestone in and near the areas mapped, but in the central and eastern part of the state where they are buried under Pennsylvanian rocks they contain much siltstone and cherty limestone. The upper Mississippian rocks (M^2) consist of a succession of sandstone, shale, and limestone formations.

This system of rocks takes its name from the Mississippi River because there are excellent exposures of these strata along the Mississippi Valley in western Illinois, southeastern Iowa, and eastern Missouri.

The Mississippian rocks are a source of limestone, fluorspar, zinc, and ganister, and are of greatest economic significance in southeastern Illinois where they are the most important of our oil-producing rocks.

The Devonian (D, dark gray on the map), Silurian, (S, violet), Ordovician (O, light pink), and Cambrian (Є, deep pink) rocks, in the order named, are older than the Mississippian strata. In general, they include dolomite, limestone, shale, and sandstone. Except for small areas along the Mississippi and Illinois River Valleys, these older rocks are found at the surface only in the northern quarter of the state and locally in Alexander, Hardin, Jackson, Monroe, Pike, and Union Counties. They are nevertheless economically important because they yield limestone, dolomite, silica sand, oil, zinc and lead, tripoli, novaculite, and novaculite gravel.

The rocks of the Cambrian through Pennsylvanian Systems belong to the Paleozoic Era. The Paleozoic rocks overlie crystalline rocks, such as granites, that extend to unknown depths in the crust of the earth. The crystalline rocks are not exposed in Illinois but are encountered in the drilling of some deep wells and may be seen in the nearby Missouri Ozarks and in central Wisconsin.

STRUCTURAL GEOLOGY

The rock formations appear to lie flat in most of Illinois, but they are slightly inclined in most places. In some areas they are down-warped into basins and troughs (synclines), upfolded into domes and arches (anticlines), or broken by faults.

The largest structural feature in Illinois is a great spoon-shaped basin — the Illinois Basin — that extends southeastward into Indiana and Kentucky. The deepest part of the basin is in southeastern Illinois.

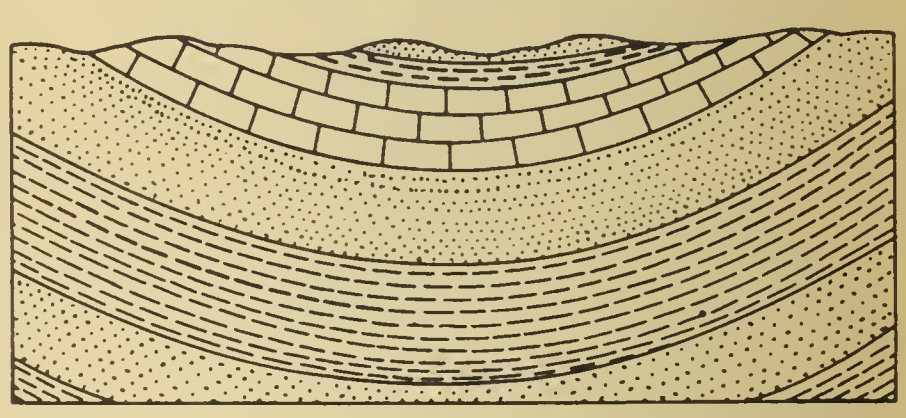


Figure 3 - When rocks are down-warped and the surface is leveled by erosion, the youngest rocks are preserved in the center and the older rocks are exposed at the margins.

Because the entire region, including the basin, has been eroded by rain, ice, wind, and many rivers and streams, the youngest Paleozoic rocks (topmost layers) are preserved only in the middle of the basin, as shown in figures 3, 6, and 7. This is why the map shows the coal-bearing rocks of Pennsylvanian age in the center of the state and the older rocks cropping out in successive bands around the margins of the basin in southern, western, and northern Illinois.

Distribution of bedrock in northern Illinois is influenced by a broad upfold or arch (see figures 4, 6, and 7). The map (plate 1) shows the older rocks (Cambrian and Ordovician) exposed at the center of the arch and surrounded by younger Silurian and Devonian rocks. Another elongated upfold (anticlinal belt) extends from the vicinity of Dixon southeastward into Indiana. The crest of the upfold is indicated on the map by patches of Silurian and Devonian rocks in Champaign and Douglas Counties.

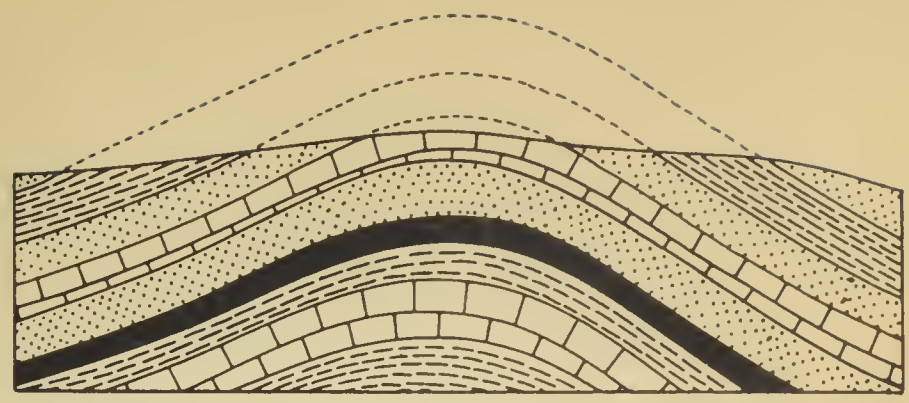


Figure 4 - When rocks are upfolded and the surface is eroded, the older rocks are exposed at the crest of the dome or anticline.

In extreme southern Illinois and in north-central Illinois, the rock layers are broken by great faults (see figures 5 and 6) which displace the layers of rocks by as little as a few inches to as much as 3,000 feet.

The structural map of Illinois (figure 6) shows the position of the major geologic structures. The big basin is indicated by shading, with the darkest pattern showing where the basin is deepest. The same strata that lie at sea level at the basin's outer edge are downwarped to 6,000 feet below sea level in its deepest part. Axes of some small anticlines and locations of major fault zones also are shown.

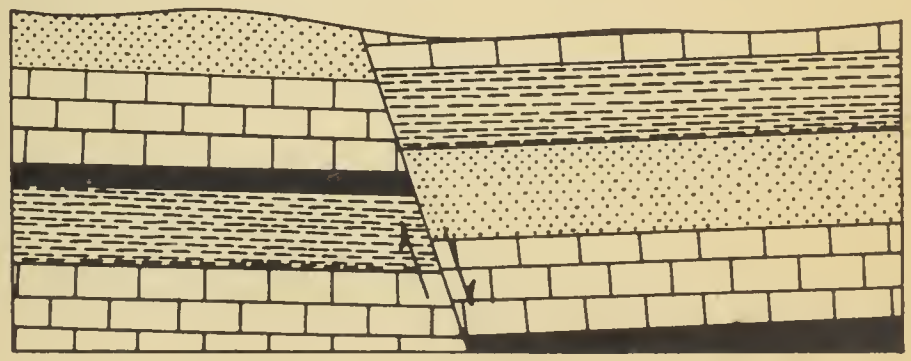


Figure 5 - When rocks are faulted by earth stresses, the layers of rock are displaced or offset.

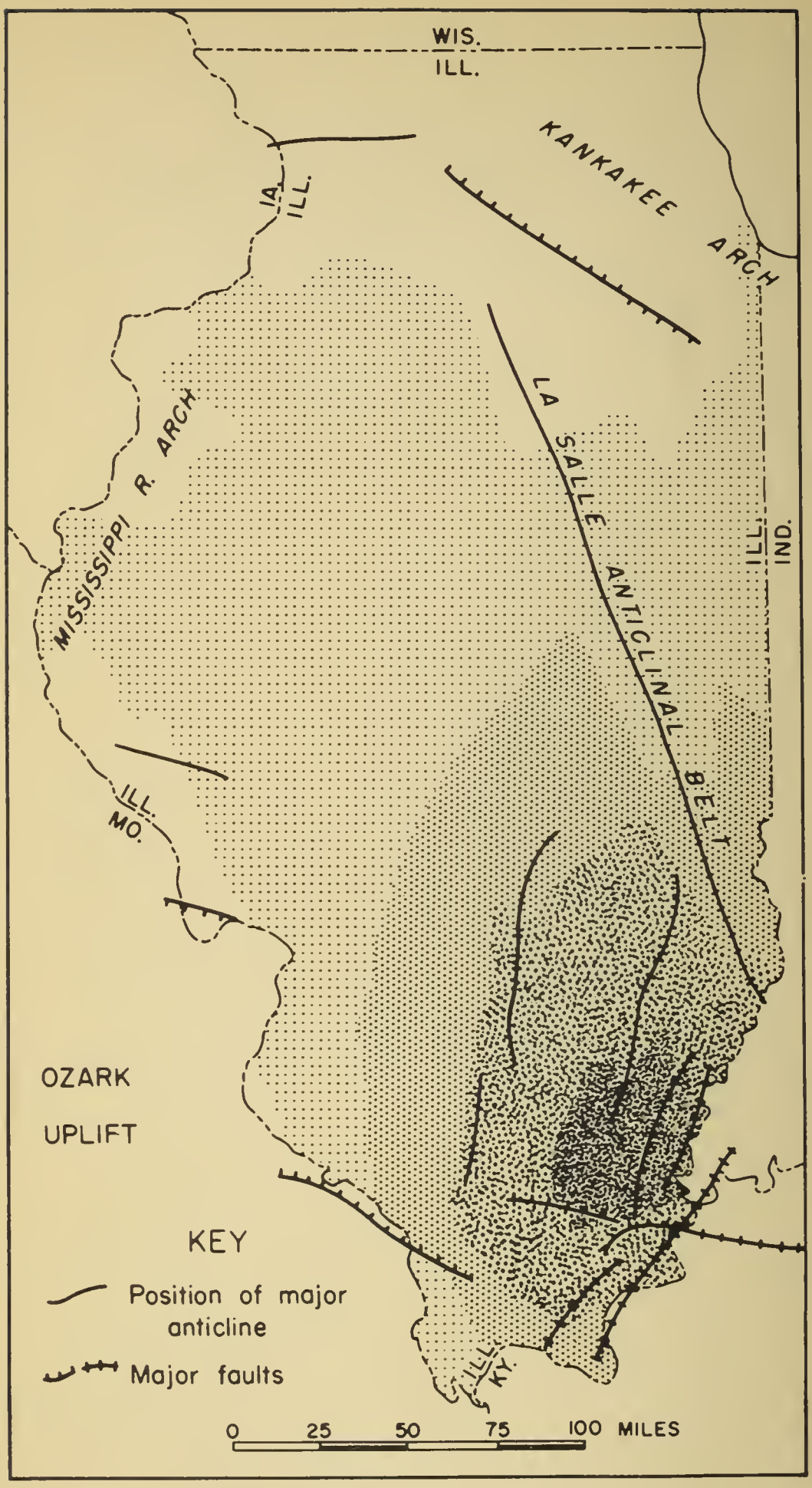


Figure 6 - Major structural features of Illinois - the Illinois Basin, anticlines, and faults. The increasing depth of the basin is shown by progressively darker patterns.

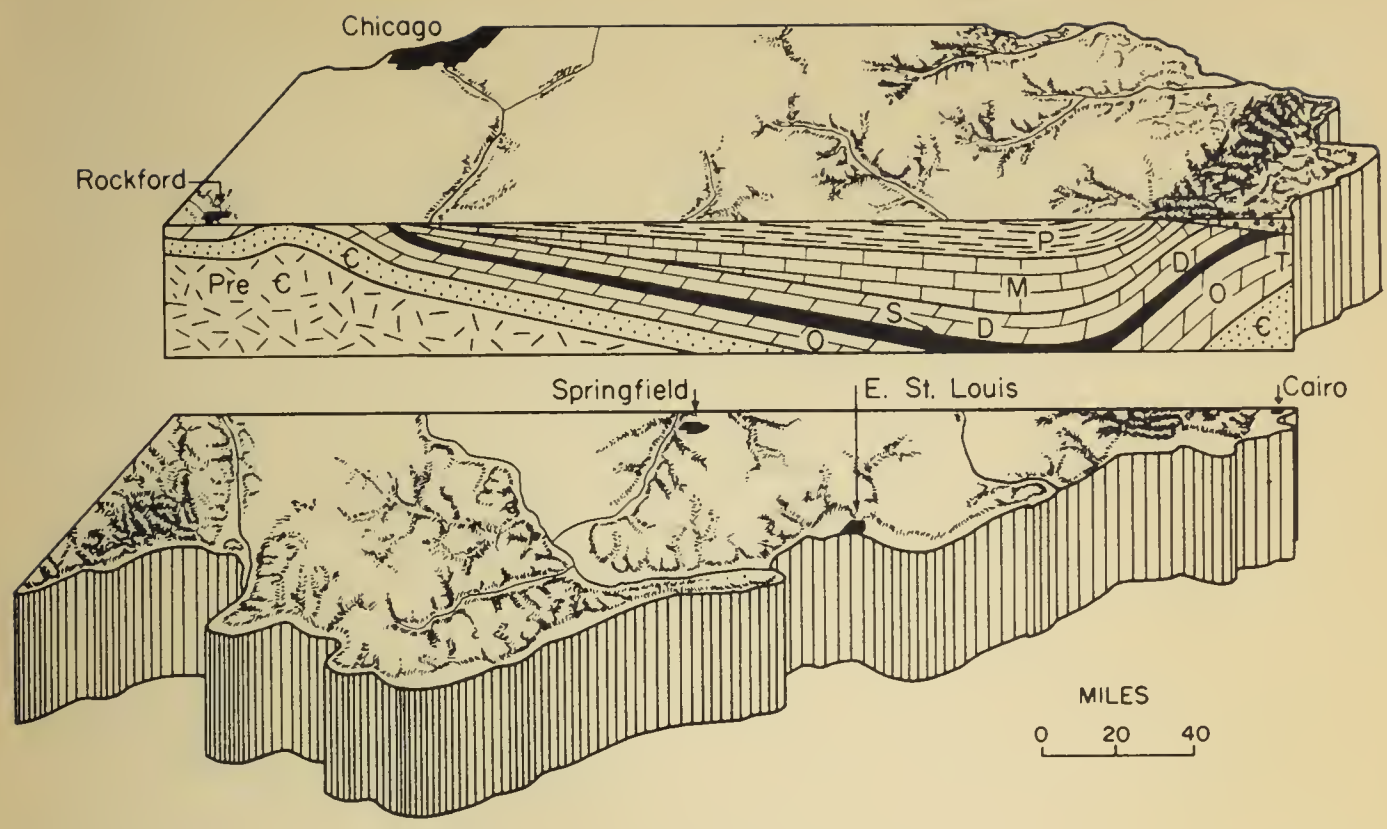


Figure 7 - The cross section from north to south through Illinois shows the strata down-warped into the basin.

HISTORICAL GEOLOGY

Reading the history of the earth's crust is like reading a mystery story. The geologist must examine, or read, each rock layer, from the youngest at the top to the oldest at the bottom, searching for clues to its origin, age, and development from which he can reconstruct the past.

One of the clues to the past is the fossil remains of plants and animals found in the rocks. For instance, if a certain coral is known to have lived only during one span of time, all rocks containing that coral fossil must have been formed within that span.

Records of wells (well logs) and rock cores or samples collected when test holes are drilled into the bedrock also reveal much about the sequence of rock strata beneath the surface. The kinds of rocks encountered tell, in addition, something about ancient geography, for

some were formed on land and others were deposited in long-departed seas.

Such knowledge is extremely important in finding and developing mineral resources such as coal and oil.

ECONOMIC GEOLOGY

Minerals produced commercially in Illinois include crude oil, coal, limestone, dolomite, clay, sand, gravel, fluorspar, tripoli, ganister, novaculite gravel, silica sand, and the metals zinc and lead. The distribution of mineral industries, shown in the several maps of figures 8 through 12, is, of course, related to the distribution of the rocks (plate 1). For example, the coal mines are scattered along the margin of the area of Pennsylvanian rocks where the coals are at relatively shallow depths.

The mineral fuels, coal and petroleum, are the leading mineral products of Illinois, making up about 70 percent of the annual value of all minerals produced in the state. For many years coal was at the top of the list, but petroleum now holds first place.

Petroleum

In recent years production of petroleum has averaged about 78 million barrels each year, making Illinois the eighth largest petroleum producing state. The major oil area is the deep part of the Illinois Basin in the south-central and southeastern parts of the state, but significant discoveries have been made recently in central and western Illinois. There are about 490 oil fields in Illinois, ranging from a few to several thousand acres in size.

Oil has been discovered in rocks of the Pennsylvanian, Mississippian, Devonian, Silurian, and Ordovician Systems, but the Mississippian are the most productive and account for about 76 percent of our total oil production.

Figure 8 - Oil pools in Illinois as of January 1, 1961. The pools are concentrated mainly in the Illinois Basin and along the LaSalle Anticlinal Belt.

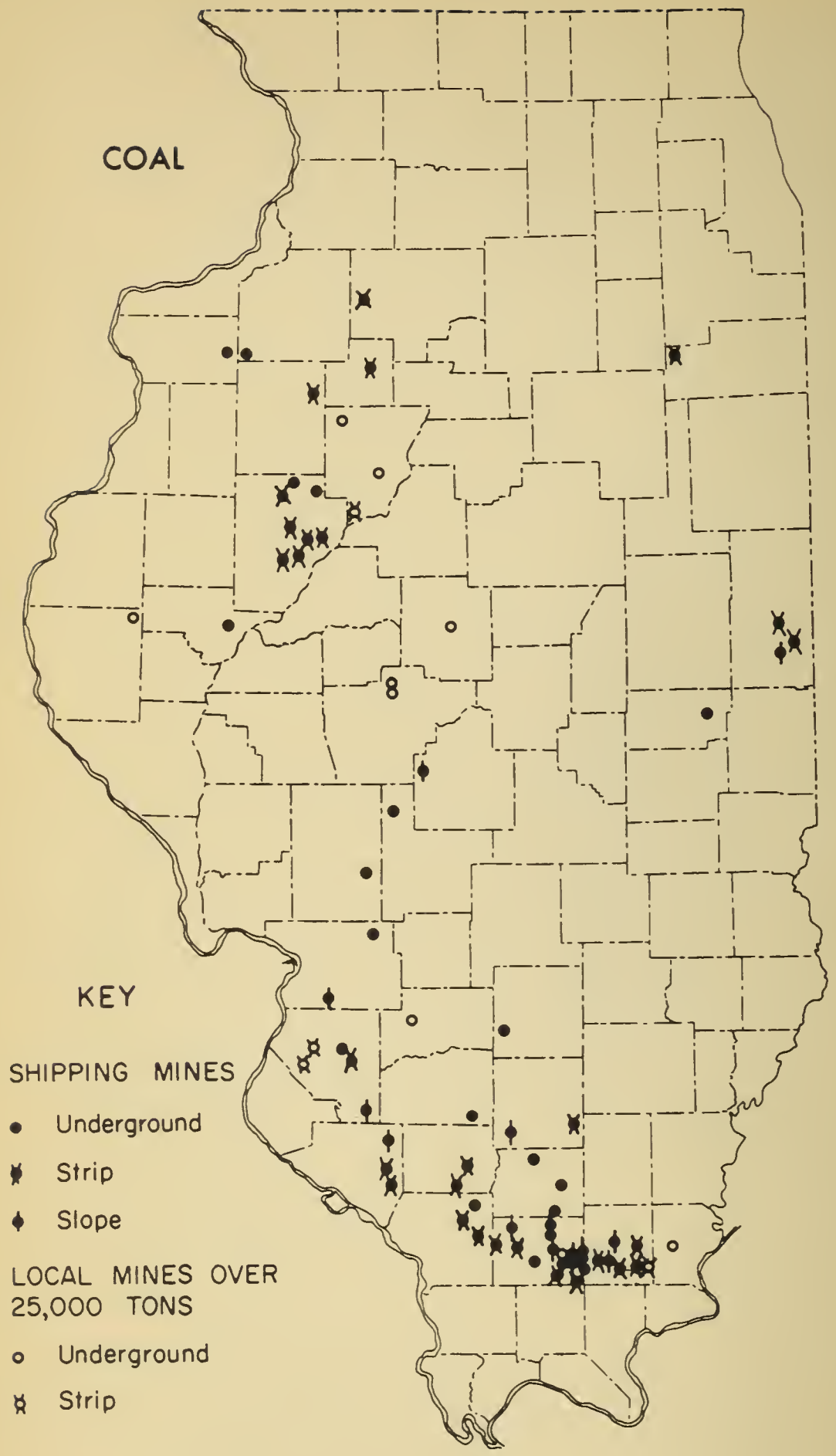


Figure 9 - Active coal mines are scattered around the margin of the basin where the coals are at relatively shallow depths.

Coal

Illinois ranks fourth in the nation among states that produce bituminous coal, the type of coal most widely mined in the United States. Coal is used by many manufacturing industries, by public utilities companies that burn coal to generate electricity, and by individuals for heating homes.

All Illinois coal deposits are found in the Pennsylvanian System. Of the many coals, only a few are thick enough to be mined profitably. The coal is of bituminous rank, but it varies in quality. Illinois coal reserves in strata more than 28 inches thick are estimated at 137 billion tons and are larger than those of any other state.

Around the edge of the coal basin where the coal lies at shallow depths, it is commonly mined in open pits (strip mines). However, in the past, most coal has been mined underground, and more than half of Illinois coal is still produced from such mines.

Limestone and Dolomite

There are two types of carbonate rocks in Illinois, limestone and dolomite. In appearance they are almost indistinguishable, although they are different chemically. Limestone is composed mainly of calcium carbonate (the mineral calcite), whereas dolomite is calcium magnesium carbonate (the mineral dolomite).

Limestone deposits are found at many places in the western, southwestern, and southern marginal portions of the state. They are largely of Mississippian and Ordovician age. Lesser deposits of Pennsylvanian limestone are found in the central portion of the state. In the northern fifth of the state, dolomites of Silurian and Ordovician age are exposed at many places.

Limestone and dolomite are quarried for a variety of uses, including aggregate for concrete, agricultural limestone, railroad ballast, chips for bituminous roads, and

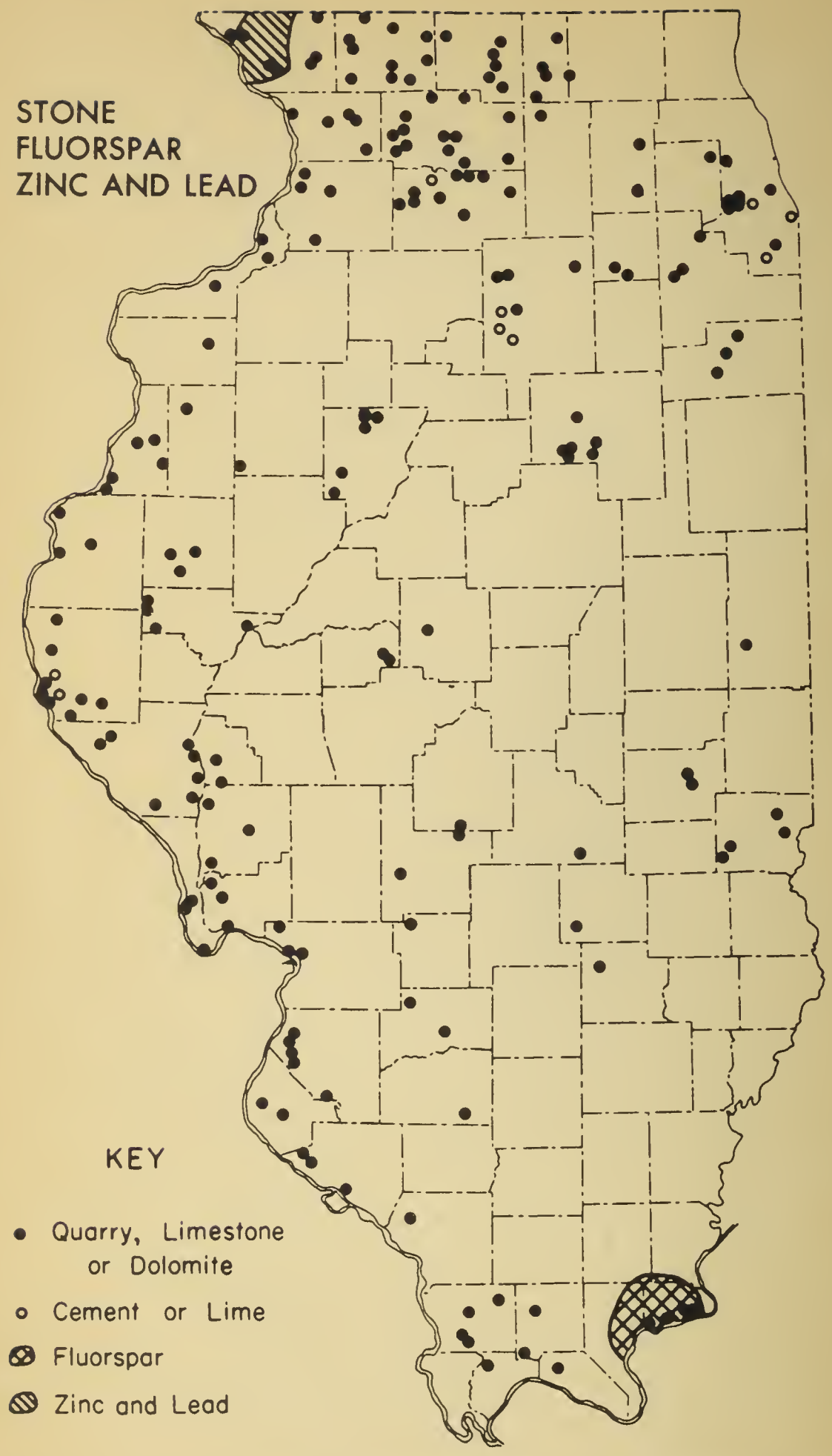


Figure 10 - Limestone and dolomite are quarried at many places, but fluorspar, zinc, and lead are produced in restricted mineralized areas.

for use in metallurgical and chemical processes. They also are quarried for building stone at some places, and marble is produced in southern Illinois.

Limestone and shale or clay are burned together in kilns to produce portland cement. Portland cement is manufactured from a Pennsylvanian limestone in LaSalle County and from an Ordovician limestone in Lee County.

Limestone or dolomite also is burned in kilns to make lime. Mississippian limestone is used in Adams County and Silurian dolomite is used in Cook County for lime making.

Clay and Clay Products

Illinois commercial clays are found in glacial, Cretaceous, Tertiary, and Pennsylvanian deposits. Pennsylvanian shales also are sources of clays. Glacial clays, which occur as loess (wind-blown materials), alluvial (water-deposited) sediments, and glacial till, are widespread in the state. Cretaceous and Tertiary clays, at the extreme southern tip of the state, are valuable for the manufacture of heat-resistant bricks and coatings and for floor-sweeping compounds.

Pennsylvanian clays and shales are the most important source of clay for manufacturing such products as pottery, stoneware, drain tile, sewer pipe, flue tile, building tile, brick, and special heat-resistant firebrick.

Sand and Gravel

Deposits of sand and gravel, found in many parts of Illinois, provide large quantities of material for concrete, railroad ballast, road gravel, building sand, molding sand, and other uses. Glacial deposits are the principal sources of sand and gravel, but in extreme southern

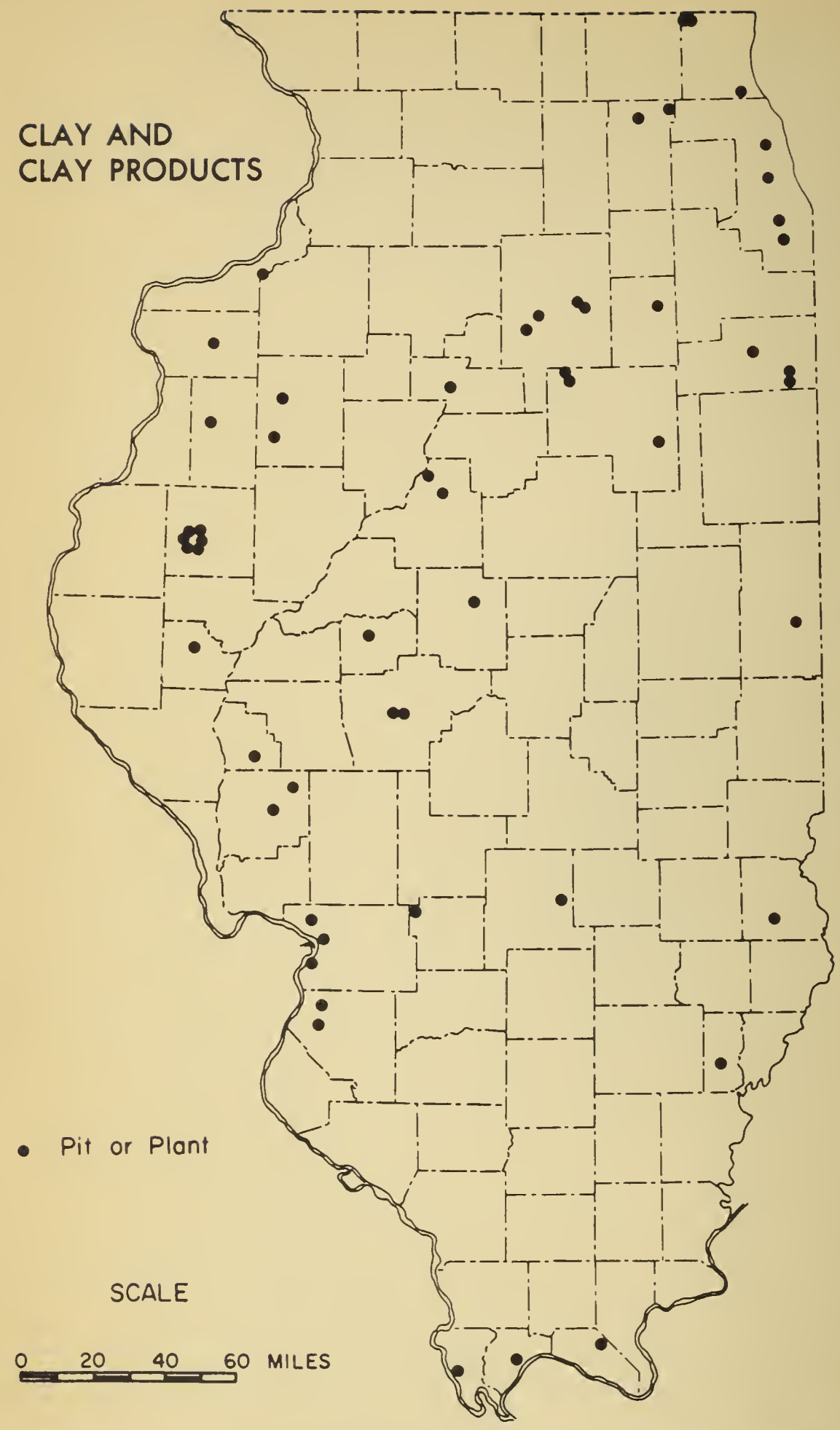


Figure 11 - The clay industry is scattered widely in Illinois. Many manufacturing plants are located at the clay pits.

Illinois where there is no glacial drift the main source of supply is Tertiary gravel and Devonian chert gravel.

Almost every county has some sand and gravel, but the major areas of production are northeastern Illinois and some of the major rivers. Considerable tonnages of sand and gravel are dredged from bars in the channels of the Mississippi, Ohio, and Wabash Rivers.

Silica Sand

Silica sand is used in making glass, for sand blasting, as grinding sand, as molding sand for casting steel, and in the fracture treatment of oil wells to increase oil production. Some of the sand is finely pulverized into a powder that is used as a filler, a fine abrasive, as a ceramic material, and for many other purposes.

This special sand, composed of grains of the mineral quartz (silica), comes from a sandstone of Ordovician age that is mined in LaSalle and Ogle Counties.

Tripoli and Ganister

Tripoli, or "amorphous" silica, is mined from Devonian rocks in Alexander County. The silica is finely ground for use as a polishing agent, as a filler, in buffing compounds, and for other purposes.

Ganister, a granular material with a high silica content, also is mined in extreme southern Illinois. It is used in making products that can withstand high temperatures.

Fluorspar

For many years Illinois has led the nation in the production of fluorspar, accounting annually for about

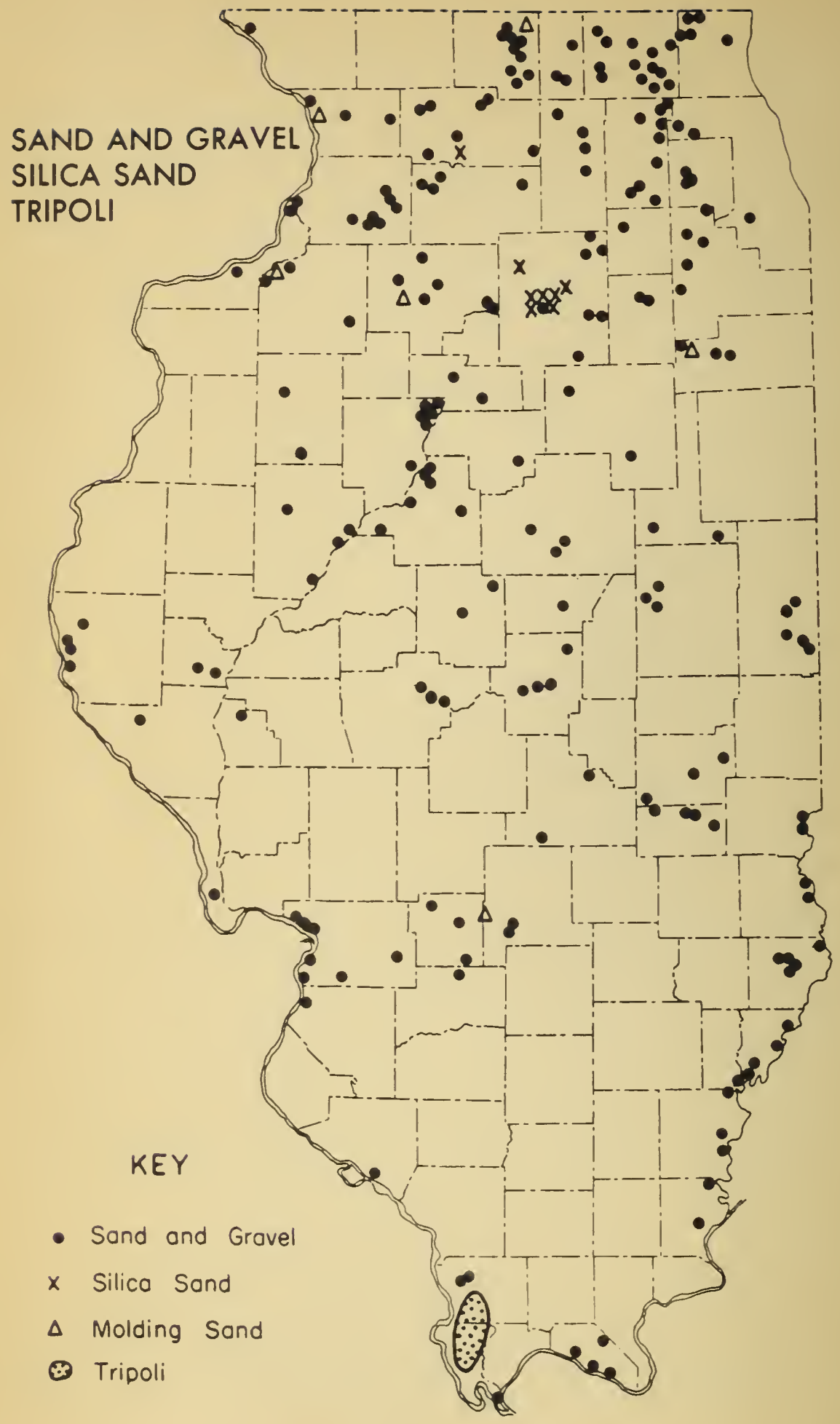


Figure 12 - Sand and gravel is produced at many places in the state. Silica sand is produced only from a sandstone in northern Illinois. Tripoli is found only in southern Illinois.

half the total United States output. The industry is centered in Hardin and Pope Counties where the deposits occur in veins and beds in rocks of the Mississippian System. Reserves of fluorspar are adequate to supply the industry for many years.

Fluorspar is used in the manufacture of hydrofluoric acid, as a flux in the manufacture of steel, in the refining of aluminum, for the manufacture of fluorine compounds used in a variety of products, in ceramic glazes, and for other special purposes.

Lead and Zinc

Lead and zinc are the only metallic minerals mined in Illinois. Deposits are found in Jo Daviess County in northwestern Illinois and in the fluorspar area of Hardin and Pope Counties in extreme southern Illinois. In northwestern Illinois the ore occurs in rocks of Ordovician age, but in southeastern Illinois it is associated with fluorspar in rocks of Mississippian age.

Between 1820 and 1865, the mining area of which northwestern Illinois is a part was the nation's principal producer of lead ore. In recent years production of zinc has increased and that of lead has decreased.

Water Supplies

Water, too, is a mineral resource, and our most necessary one. The source of nearly all water is rain and snow, which collect in lakes and streams or seep into the ground to form our two types of water supplies — surface water and ground water.

Ground water in Illinois collects underground in deposits of sand and gravel or in the porous sandstone or limestone layers of bedrock. These rock materials are called "aquifers" because of their ability to hold water and to allow it to flow into wells that are drilled into them.

The aquifers are not equally distributed throughout Illinois, so ground-water supplies are abundant in some parts of the state but are scarce in others. Some Illinois cities depend wholly or partly on surface supplies from lakes and rivers.

The sand and gravel aquifers yield more ground water than any others in Illinois. The major sand and gravel aquifers were deposited by streams and lie along river valleys. Some of these river valleys are no longer visible to us because they were buried by glacial drift. They are recognized, however, from well records or drilling records.

The northern third of Illinois has the most abundant supplies of ground water. Bedrock formations of Devonian through Cambrian age are favorable aquifers and supply drinkable (potable) water at depths of from 200 to 2,000 feet. These formations, however, lie much deeper in the Illinois Basin, where the water they furnish is too salty for most uses.

West of the Illinois River and at the southern tip of the state, the Mississippian, Devonian, and Silurian limestones are the chief aquifers. Their yield, however, is small.

In the Illinois Basin all these formations are overlain by Pennsylvanian rocks which offer only small, scattered supplies of ground water.

ILLINOIS STATE GEOLOGICAL SURVEY

A city or farmer needs a new water supply. Where can suitable water-bearing formations be found? A new limestone quarry is considered. Where are the most suitable limestone deposits? A coal mine is being planned. How deep must a shaft be sunk to reach the nearest minable coal and what will the mining conditions be? A land owner has a clay deposit on his land. What uses can be made of it? A road is to be constructed. Are sand and gravel or limestone deposits available nearby for construction materials? A farmer wants to know whether

there might be oil on his property. Are oil-bearing structures present and, if so, at what depth?

These are typical questions brought to the Illinois State Geological Survey by the industries and people of Illinois. From its accumulated store of information and experience, the Survey provides answers. This storehouse of knowledge is the result of the Survey's continuous program of geologic exploration, mapping, research, and organization and interpretation of data.

The Survey explores and maps the geology and mineral resources of the state, does research to find new and improved uses for our mineral resources, and organizes and interprets basic geologic information gathered from well logs, rock samples, and field studies, putting them all into usable form.

Such knowledge is shared with the public through publications, maps, lectures, and personal consultations with industries, drillers, engineers, land owners, teachers, and others in need of geologic information.

The discovery of facts about the rich mineral resources of Illinois has, in effect, only begun, and it is the task of the Geological Survey to continue to collect and apply new information so that our resources can be used to the best advantage.

EDUCATIONAL EXTENSION PROGRAM

The Educational Extension Section of the Geological Survey conducts six field trips each year, in various parts of the state, for teachers, students, and laymen. It also assembles and distributes rock and mineral collections for Illinois educational groups, gives lectures, prepares exhibits, and identifies rocks and minerals for the public.

Educational Extension publications, such as this book, are simplified discussions of geological subjects. Available for 25 cents each, these include:

Educational Series 4: Guide for Beginning Fossil Hunters, by Charles W. Collinson.
Educational Series 5: Guide to Rocks and Minerals of Illinois.
Educational Series 6: Field Book of Pennsylvanian Plant Fossils of Illinois, by Charles Collinson and Romayne Skartvedt.

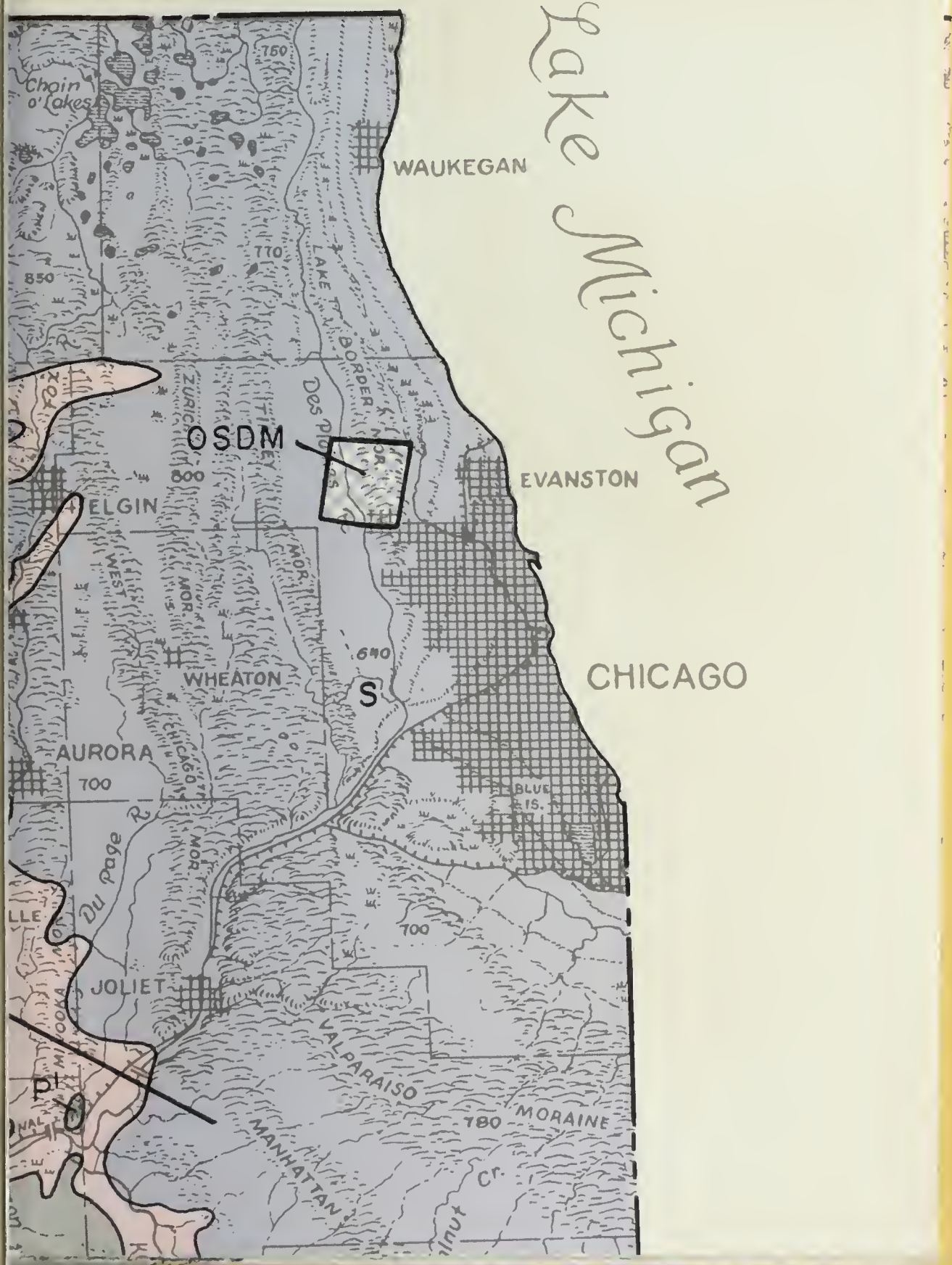
Many technical discussions of the various phases of Illinois geology also are published by the Geological Survey. Regional reports on the geology and mineral resources of some areas are available in many school and public libraries or they may be purchased from the Survey. Some of the regional reports include:

Beardstown, Glasford, Havana, and Vermont Quadrangles, Bulletin 82, $1.00.
Buda Quadrangle, Circular 275, no charge.
Carlinville Quadrangle, Bulletin 77, $1.00
Chicago Region, Bulletin 65, Part 1, 50 cents.
Marseilles, Ottawa, and Streator Quadrangles, Bulletin 66, $1.00.

"Mineral Production in Illinois in 1959," Circular 300 (no charge), is one of a series of annual economic summaries. "Caves of Illinois," Report of Investigations 215, price 50 cents, will be available by September 1961.

Illinois State Geological Survey Educational Series 7
24 pages, 1 plate, 12 figures, 1961

Educational Series 7 — Plate 1



GEOLOGIC MAP OF ILLINOIS
showing
BEDROCK BELOW
THE GLACIAL DRIFT
1961

Lake Michigan

KEY

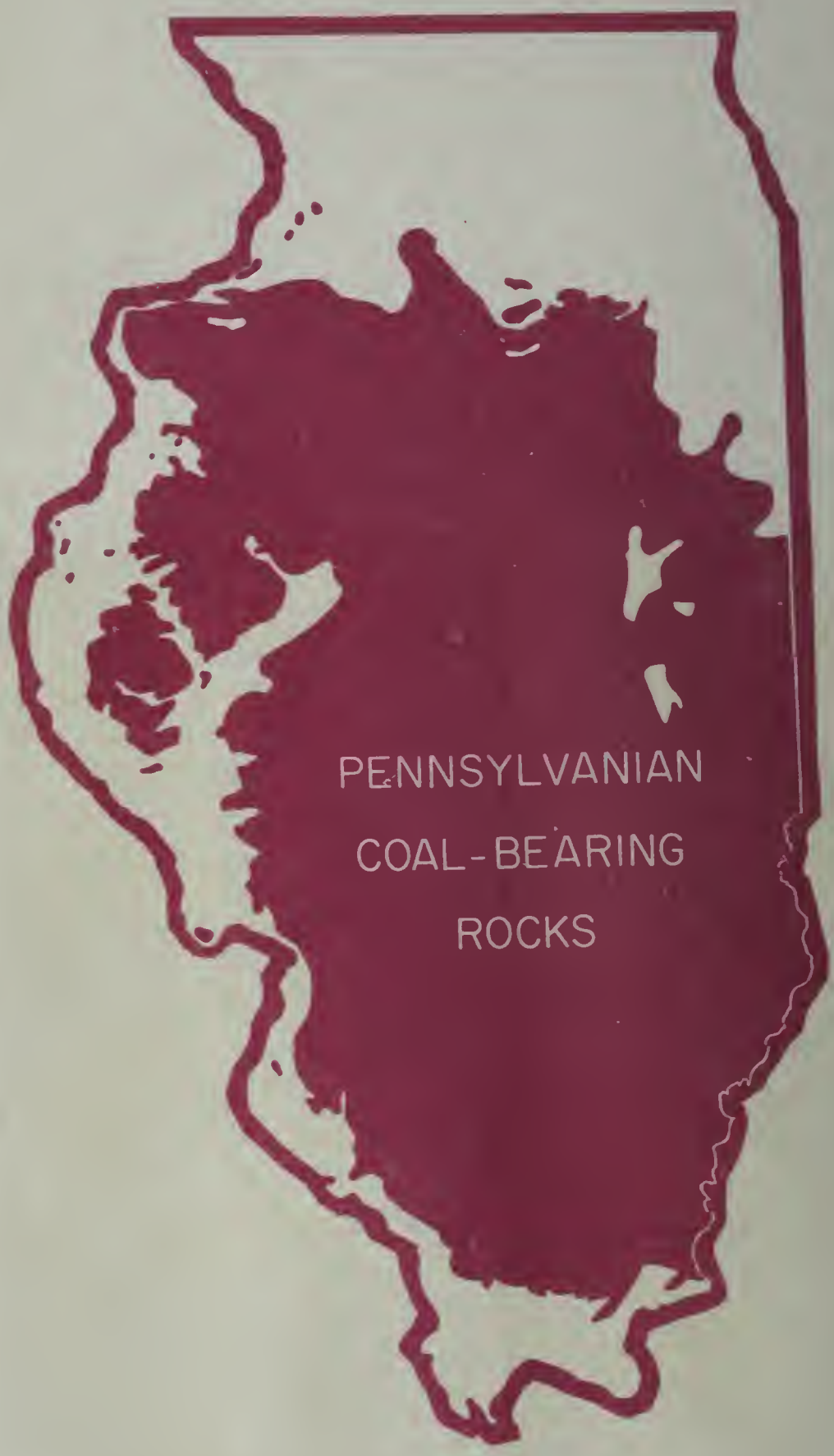
- T — Tertiary (Pliocene amitted)
- K — Cretaceaus
- P^2 — Pennsylvanian (Abave No. 6 Caal)
- P^1 — Pennsylvanian (Belaw No. 6 Coal)
- M^2 — Mississippian (Upper)
- M^1 — Mississippian (Middle and Lawer)
- D — Devanian
- SD — Silurian and Devanian
- S — Silurian
- O — Ordavician
- C — Cambrian
- F — Fault
- OSDM — Camplex faulted area

MILES
0 10 20 30 40 50

Physiographic base map by
James A. Bier

Price, 25 cents

ILLINOIS
Land of Lincoln



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